The Global Distributions of HCN and HC$_3$N on Titan

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The atmosphere of Titan has several important nitrogen-bearing species, including hydrogen cyanide (HCN) and cyanoacetylene (HC$_3$N). Their abundances are governed by a complex photochemical and thermal environment. Detailed observations of the distributions of these nitriles are important for constraining chemical models and improving our understanding of the conditions of Titan's atmosphere and surface.

Spectroscopic observations of HCN and HC$_3$N were obtained in November 1995

using the Owens Valley Radio Observatory Millimeter Array, consisting of six 10.4-meter diameter dish antennas. Titan's small size ($\sim 0.8''$ diameter) did not allow us to spatially resolve the moon, and therefore these observations pertain to disk average conditions, favoring low to mid-latititudes.

•HCN. Hydrogen cyanide exhibits a broad (several hundred MHz wide) emission lineshape, since the stratosphere is warmer than the surface and troposphere. Numerical inversion of the lineshape shows the HCN mixing ratio increases from about 5×10^{-8} at 100 km to greater than 1×10^{-6} at 300 km. These results fall between the results found by Tanguy *et al.* (1990) and Hidayat *et al.* (1996). In addition, these observations for the first time allow the determination of the HCN condensation altitude in the lower stratosphere, at 100 ± 15 km. This result is slightly higher but consistent with the condensation altitude expected from vapor pressure relations for HCN currently in use.

•HC$_3$N. In contrast, cyanoacetylene has a very narrow line, significantly less than 1 MHz in width. The narrow lineshape demands that most of the emission occurs from above $\sim$325 km (50μbar), confirming the millimeter results of Bézard *et al.* (1992). Analysis of the unresolved line's strength and lack of emission wings shows that it can be fit equally well by a model of a constant mixing ratio of 1×10^{-8} above 325 km, or a mixing ratio profile that increases rapidly from less than 3×10^{-10} at 300 km to 2×10^{-8} at 400 km. In either case, the mixing ratio of HC$_3$N below ~ 300 km (100 μbar) is less than 3×10^{-10}, and the column density above 300 km is $\sim 1 \times 10^{14}$.

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